

# Exercise as a Therapeutic Strategy for Managing Low Back Pain: A Systematic Review

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## ABSTRACT

The study aimed to analyze research on exercise as a therapeutic strategy for treating low back pain (LBP), with a focus on its effectiveness and exercise modalities. PRISMA guidelines were used in this systematic review. The retrieved articles were published from 2020 to 2024 and focused on the management of LBP with exercise. The literature search was conducted on 5 main bases. Boolean operators and specific keywords were used. The Cochrane Collaboration and the Physiotherapy Evidence Database (PEDro) scale were used to assess the risk of bias. This systematic review synthesized all the studies identified. Exercise is an effective core therapeutic strategy for managing LBP. An educational program; Back School Program significantly increased physical activity and reduced pain intensity compared to standard therapy. Non-pharmacological approaches, including Transcutaneous Electrical Nerve Stimulation aimed at evaluating exercise modalities and gym ball therapy, have shown significant results in pain management in various populations, including pregnant women and athletes.

In conclusion, the integration of physical activity with therapeutic modalities (massage and cognitive behavioral therapy) is essential for a holistic approach to pain management. Therefore, exercise should be considered the primary approach of managing LBP, although adjunctive treatment can contribute to patient recovery. Hence, strengthening an exercise regimen should be an integral part of clinical interventions for LBP.

**KEYWORDS:** Low Back Pain, Exercise, Therapeutic, Pain

## INTRODUCTION

Low back pain (LBP) is a common condition that affects a large portion of the world's population, with 60% to 85% of individuals experiencing it at some point in their lives. In many cases, this condition is often a cause of disability and also contributes to lost productivity and health care costs<sup>1</sup>. The multifactorial nature of LBP can originate from inflammatory, mechanical, or psychological factors<sup>2</sup>. Various therapeutic strategies have emerged and become the basis for the management of LBP, some of which have proven effective in reducing pain due to LBP<sup>3</sup>. Some of the known benefits of therapeutic exercise in the management of LBP are attributed to various mechanisms. Muscle strength, endurance, and flexibility can be improved with regular physical activity. This can maintain spinal stability and prevent further injury due to a lack of regular physical activity<sup>2</sup>. Modulation of pain perception through central pain modification mechanisms with exercises that can

stimulate the release of endorphins. By improving metabolic health and reducing obesity-related inflammation, exercise may play a role. Exercise works to reduce inflammation, a common contributor to chronic pain<sup>4</sup>. A sense of control and empowerment in patients, which is known to ease the psychological burden associated with chronic pain, can be achieved through exercise<sup>1</sup>.

Pain management and improvement of functional outcomes in patients with nonspecific LBP with exercise modalities, one of which is core stabilization exercises. In patients with nonspecific LBP, core stabilization exercises, in conjunction with specific hip strengthening exercises and conventional rehabilitation therapy, have been shown to improve pain relief and enhance functional outcomes<sup>5-7</sup>.

The intensity of maximal and optimal exercise remains an area of active research for pain management. Some interventions still need further investigation, such as beneficial exercise interventions and various types of exercise, such as aerobic, resistance, and flexibility exercises<sup>3,8</sup>. The role of patient-specific factors, such as baseline fitness level, age, and presence of comorbidities, can influence the outcomes of exercise interventions<sup>3</sup>. Therefore, it is deemed necessary for this exercise program to consider these factors to improve treatment efficacy.

Research into exercise as a therapeutic strategy for managing LBP is essential due to the high prevalence and substantial impact of LBP on individuals' quality of life and healthcare systems. Recent studies

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underscore that targeted exercise interventions, particularly core stability exercises, can significantly alleviate pain and enhance functional capacity among patients with chronic low back pain (CLBP) <sup>9,10</sup>. Moreover, systematic reviews indicate that integrating exercise with self-determination theory (SDT) can improve patient adherence and outcomes, suggesting a multifaceted approach to LBP management <sup>11</sup>.

The research gap this study addresses concerns the need for clarity about specific exercise modalities and their effectiveness in managing CLBP. The primary objective of this study was to analyze and synthesize relevant evidence on the efficacy of exercise in the management of LBP and to explore the various exercise modalities that contribute to clinical improvement. The novelty of this study lies in its emphasis on the effectiveness of exercise interventions as a therapeutic strategy of managing LBP, particularly through the implementation of various exercise modifications. Taking into account recent developments from 2020 to 2024, this study presents a systematic approach, following PRISMA guidelines, to summarize current findings and assess risk of bias using the Cochrane and PEDro scales.

## METHODOLOGY

The primary objective of this study was to analyze and synthesize relevant evidence on the effectiveness of exercise in the management of LBP and to explore the various exercise modalities that contribute to

clinical improvement. To ensure comprehensive and transparent reporting of the systematic review process, this study followed the Preferred Reporting Items for Systematic Reviews guidelines.

### PROSPERO Register Number

This research has been registered with the PROSPERO Database under the Registration Number Kasim Jaiddin, Arisandy Achmad. Exercise as a Therapeutic Strategy for Managing Low Back Pain: A Systematic Review. PROSPERO 2025 CRD420251009355. Available from <https://www.crd.york.ac.uk/PROSPERO/view/CRD420251009355>

### Eligibility Criteria

The review included studies published in clinical trials between 2020 and 2024 that focused on the implementation of exercise interventions to manage LBP and articles available in English. The criteria were selected based on PICO as listed below.

**Population:** Women and Men with complaints and diagnoses of CLBP due to work. (Table I)

**Interventions:** Various forms of therapeutic exercise, including aerobic, strengthening, and flexibility programs. (Table I)

**Comparisons:** The control group consists of individuals who do not receive any treatment or intervention. (Table I)

**Outcomes:** included studies had to report one of the following: the Numeric Pain Rating Scale (NPRS), pain intensity, functional capacity, or quality of life. (Table I)

**Table I: Eligibility criteria based on PICO framework**

| PICO          | Inclusion Criteria                                                                                                                                                                                                                                                                                                                                          | Exclusion Criteria                                                                                                                |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Population    | Participants in various sectors especially livestock, fields, and plantations, of all ages and genders                                                                                                                                                                                                                                                      | 1. Post-Op Spinal Surgery<br>2. Fracture condition<br>3. Tumor condition<br>4. Farming activities using modern tools and machines |
| Intervention  | Various forms of exercise, such as aerobic exercise, strength training, stretching, yoga, Pilates, and physical rehabilitation programs, are designed to reduce back pain.                                                                                                                                                                                  | 1. Injection<br>2. High-dose pain medication usage<br>3. Spinal Surgery                                                           |
| Comparison    | standard care, conventional intervention, other non-exercise interventions                                                                                                                                                                                                                                                                                  | 1. Spinal Surgery<br>2. Injection<br>3. High-dose pain medication usage                                                           |
| Outcomes      | VAS (Visual Analog Scale)<br>ODI (Oswestry Disability Index)<br>NPRS (Numeric Pain Rating Scale)<br>Roland-Morris Disability Questionnaire (RMDQ)<br>ROM (Range of Motion)<br>Pain Disability Index<br>MMT (Manual Muscle Testing)<br>EMG (Electromyography)<br>Core Stabilizer Pressure Biofeedback<br>WHO-QOL (World Health Organization Quality of Life) | 1. Hamilton Anxiety Rating Scale and any mental test<br>2. Generalized Anxiety Disorder                                           |
| Settings      | All Countries                                                                                                                                                                                                                                                                                                                                               | -                                                                                                                                 |
| Study Designs | RCT<br>Quasi-Experimental<br>Experimental study<br>Case Study                                                                                                                                                                                                                                                                                               | 1. Cross-sectional studies<br>2. Case-control studies<br>3. Prospective cohort studies                                            |

### **Information Source and Searches**

A comprehensive literature search was conducted from January 2020 to 2024 across five major databases: Scopus, ProQuest, Web of Science, and ScienceDirect. To identify studies on exercise interventions for LBP, a systematic search was conducted using various keywords. The last search was conducted on December 30, 2024. The Boolean search strings employed were as follows: ("low back pain" OR "LBP" OR "chronic low back pain") AND ("exercise therapy" OR "exercise interventions" OR "physical activity" OR "strength training" OR "aerobic exercise")

To ensure a thorough search, references from relevant studies were also hand-searched for additional articles meeting the eligibility criteria. The studies included were peer-reviewed, published in English, and examined the effects of exercise interventions on LBP in adults. The search was updated regularly, and any studies published before or after the specified period that met the inclusion criteria were considered. Additionally, a search for grey literature, such as government reports or conference proceedings, was performed to identify any studies not indexed in the databases.

### **Study Selection**

All records identified during the search process were imported into Microsoft Excel for organization and management. Two independent reviewers conducted the initial screening of studies, ensuring consistency and cross-checking of results. The reviewers assessed the titles, abstracts, and full texts of studies based on the inclusion and exclusion criteria established for this review. Studies that did not meet the eligibility criteria were excluded, and any disagreements regarding eligibility were resolved through discussion between the two reviewers. The final set of full-text articles that met the inclusion criteria was selected for data extraction and qualitative analysis.

### **Data Synthesis**

The synthesis of data from included studies was primarily qualitative, focusing on thematic analysis of exercise modalities and their effects on LBP. Given the heterogeneity in study designs, interventions, and outcome measures, a meta-analysis was deemed inappropriate. Therefore, relevant findings on pain intensity, functional capacity, and quality of life from various studies were categorized thematically, allowing identification of consistent trends across the evidence base.

### **Data Collection**

Data extracted from the included studies included: the authors and publication date of each study, type and details of the exercise interventions (e.g., aerobic exercise, strength training, flexibility programs), the population of adults included in the study, the setting in which the interventions were delivered, and the primary outcomes measured (such as pain intensity, functional ability, and quality of life). The intensity,

duration, and frequency of the exercise interventions were also noted. The design of each study (e.g., randomized controlled trials, cohort studies) and the authors' conclusions about the efficacy of the interventions were recorded. In cases where multiple studies addressed similar interventions, the reviewers noted any updates or new findings from more recent studies that superseded older evidence. All necessary data to answer the research questions were provided in the published articles, and no direct contact with the authors was required. Any disagreements in the selection of full-text articles were resolved by consensus between the two reviewers.

### **Quality Assessment**

Two independent reviewers (e.g., Reviewer 1 and Reviewer 2) assessed the risk of bias in the included studies. To evaluate risk of bias in controlled trials, the Cochrane Collaboration Risk of Bias Scale was used, assessing 6 main categories: selection bias, performance bias, attrition bias, reporting bias, and other potential sources of bias. The categories evaluated were grouped into low, high, and unclear bias.

Quality assessment of the studies used the Cochrane Collaboration Risk of Bias Tool for randomized controlled trials (RCTs) and the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) for quasi-experimental studies. The Physiotherapy Evidence Database (PEDro) scale was used to evaluate the methodological quality of trials, ensuring rigorous assessment of bias risk across different study designs. Any discrepancies in bias evaluations were reconciled through discussion, enhancing the credibility of the assessment process.

## **RESULTS**

Four main databases were used as search engines in the systematic search, including Scopus, ProQuest, Web of Science, and ScienceDirect. The systematic search results found a total of 13,892 articles. The next step was to remove flagged duplicate articles and filter them according to eligibility criteria. Therefore, 38 articles were included in the final analysis stage that specifically discussed exercise-based interventions in the management of LBP.

Various systematic reviews show that pharmacological interventions can be used to treat LBP. In the study of Hock M et al.<sup>12</sup>, the Back School Program (BSP) is more effective than regular exercise therapy at reducing chronic nonspecific low back pain (cnsLBP) and increasing physical activity. Structured physical therapy has been shown to increase spinal mobility and improve athletes' quality of life<sup>13</sup>. Through group physical activity for unresolved back pain, health improvements can also be achieved<sup>14</sup>. TENS therapy<sup>15</sup>, Endorphin massage therapy<sup>16</sup>, and Combined rehabilitation<sup>17</sup>, also demonstrated significant pain relief. More details are shown in **Table II**.

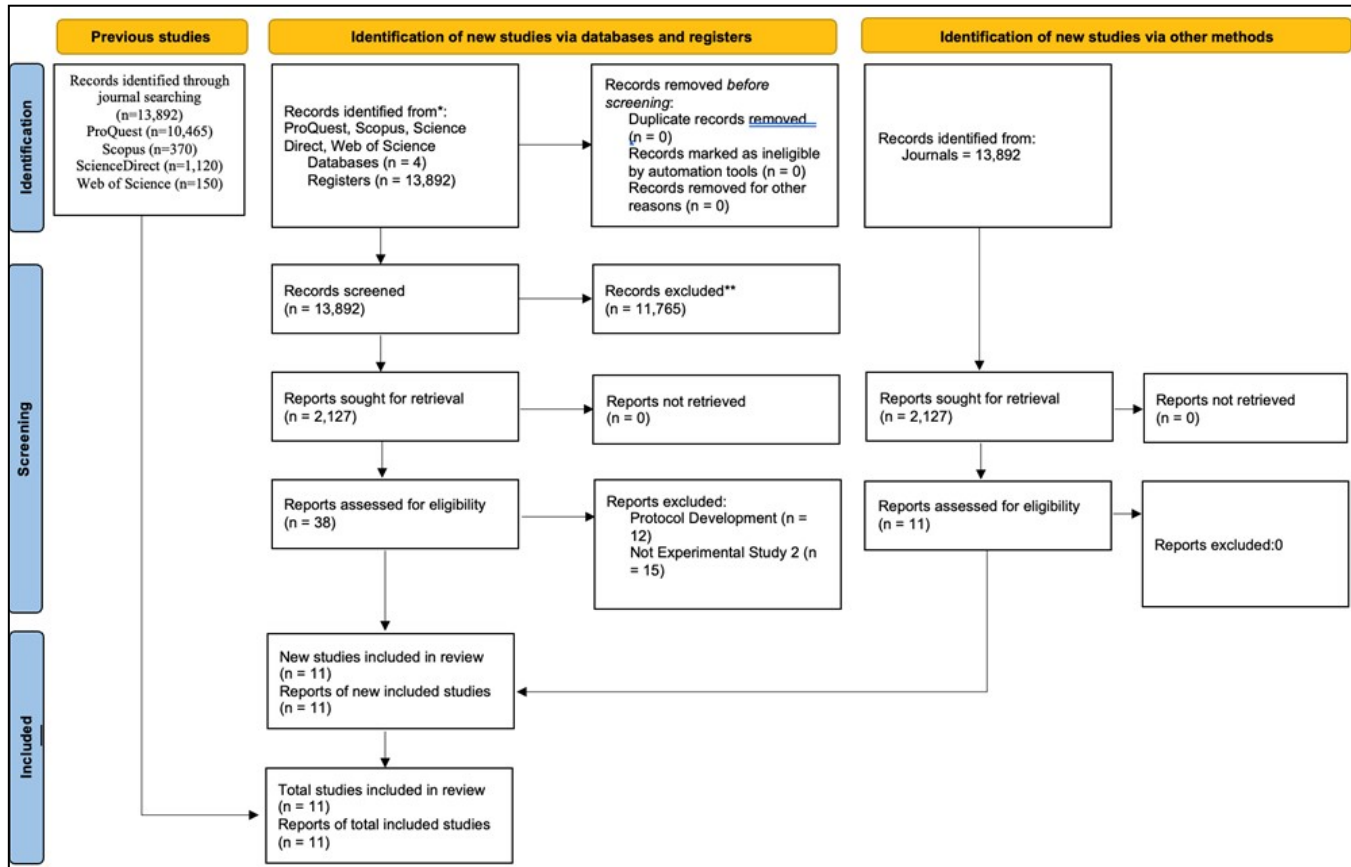


Figure 1: PRISMA 2020 flow diagram for the process of study selection

Table I: Summary of Results

| Authors | Type of Intervention                                                                                                                                                                                            | Sample                                                                                                                                                                                                                                  | Intervention                                                                                                                                                                                                                                                                                                                                                          | Conclusion                                                                                                                                                                                                                                                                                                                  |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12      | The study uses the Back School Program (BSP) to educate patients on managing low back pain (LBP) and encourage physical activity as a treatment and prevention method.                                          | The study participants were 306, including healthy individuals and patients with chronic nonspecific low back pain (cnsLBP), stratified into three groups: healthy patients, BSP-enrolled patients, and exercise therapy-only patients. | The study included 306 participants, including healthy individuals and patients with cnsLBP, stratified into three groups: healthy patients, BSP-enrolled patients, and exercise therapy-only patients.                                                                                                                                                               | The study found that cnsLBP patients who participated in the BSP showed lower sedentary behaviour, increased moderate-intensity physical activity, and lower pain intensity than those receiving only exercise therapy. Participation in the program improves physical activity levels and reduces back-related disability. |
| 13      | The study implemented a structured physical therapy program for chronic back pain in old-timer athletes, specifically wrestlers, involving muscle relaxation, myocorrection, and myotonization phases.          | The study examined chronic back pain among older athletes, focusing on wrestlers who sought physical therapy intervention for their sport-related condition.                                                                            | The physical therapy program aimed to improve spinal mobility and quality of life through various modalities. These included morning hygienic gymnastics, post-isometric relaxation, hydrokinesiotherapy with traction elements, and kinesiotherapy with Pilates elements. These interventions aimed to promote physical health, flexibility, and overall well-being. | The physical therapy program significantly improved spinal mobility and quality of life for aging athletes with chronic back pain, highlighting the effectiveness of tailored interventions in managing chronic pain.                                                                                                       |
| 17      | The study explored a rehabilitation program combining pain management and pain perception in older patients with acute vertebral compression fractures (VCFs), aiming to improve daily activities despite pain. | 65 elderly adults with acute VCFs were divided into two groups: 32 in an intervention program and 33 in a control group.                                                                                                                | The intervention group underwent a rehabilitation program with pain management strategies, while the control group received standard rehabilitation without pain management. Assessments showed significant improvements in pain intensity and psychological measures.                                                                                                | Rehabilitation programs with pain management targeting perception and activity avoidance may effectively treat older patients with acute VCFs, reducing pain intensity, catastrophizing, and enhancing physical activity.                                                                                                   |

|    |                                                                                                                                                                                                |                                                                                                                                                                                                       |                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                            |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 | The study utilized regular physical activity to alleviate the intensity of back pain commonly experienced by pregnant women.                                                                   | The study participants were 34 pregnant women from Lubuk Alung Health Centre, and the study used a quasi-experimental pretest-posttest design to evaluate the intervention's effectiveness.           | The study used regular physical activity to alleviate back pain, comparing the intensity of pain before and after treatment, to measure its effectiveness.                                                                                  | The study found that physical activity significantly reduced back pain intensity in pregnant women. These interventions are effective in addressing back pain issues. The study emphasizes the importance of integrating these methods into prenatal care and suggests further exploration in medical and sports contexts. |
| 18 | The study uses Swiss ball therapeutic exercises for chronic LBP, aiming to improve spinal stabilization and overall function by challenging the body's motor control.                          | This study examines chronic low back pain (CLBP) patients aged 17-40, predominantly white-collar, who may be affected by sedentary work habits.                                                       | Participants were divided into two groups: one used a Swiss ball for back-strengthening exercises, while the other performed exercises without a ball, aiming to improve motor control and stability.                                       | Swiss ball exercises significantly reduced pain and improved range of motion in patients with CLBP, indicating their effectiveness in managing impaired motor control of spine-stabilizing muscles.                                                                                                                        |
| 19 | The study utilized a combined intervention strategy involving physical exercise to assess its cumulative impact on women's LBP.                                                                | Thirty (30) women with LBP were randomly divided into three groups of 10 each, all from Yaoundé.                                                                                                      | The intervention was a 21-day micro-program involving physical activity, divided into three groups: those who exercised solely, those who received Swedish massage sessions, and those who combined both.                                   | The study found that combining physical exercise with Swedish massage significantly reduced pain intensity and discomfort in women, suggesting an integrated approach to addressing risk factors for LBP.                                                                                                                  |
| 20 | The study utilized endorphin massage, a combination of light techniques and positive affirmations from the husband, to stimulate the release of endorphins, which are known to alleviate pain. | This study targeted 46 third-trimester pregnant women, primarily at 36 weeks of gestation, from the Pare Public Health Centre in Temanggung District.                                                 | The study used a quasi-experimental design with a non-equivalent control group, dividing participants into two groups (an endorphin massage intervention group and a control group) to analyse its effectiveness.                           | The study found that endorphin massage significantly reduced lower back pain in third-trimester pregnant women, with a stronger effect than the control group. Endorphin massage, combined with positive affirmations from husbands, can effectively alleviate pain in pregnant women.                                     |
| 15 | Transcutaneous Electrical Nerve Stimulation (TENS) therapy.                                                                                                                                    | The study participants were 71 LBP patients receiving TENS treatment in the active arm and 70 conventionally treated cases in a control group.                                                        | Patients in the active arm received TENS units, with pain scores measured before and after the intervention, while the control group's pain scores were recorded from historical data.                                                      | TENS is a viable treatment for managing LBP in the emergency department, with no significant difference in pain scores or length of stay compared to conventional treatments.                                                                                                                                              |
| 21 | The study explores gym ball therapy and back massage as non-pharmacological treatments for third-trimester pregnant women to alleviate back pain.                                              | The study participants were 30 respondents from 43 mothers in East Jakarta, divided into two groups: one receiving gym ball therapy and the other receiving a back massage, using purposive sampling. | The intervention involved two approaches: Gym Ball Therapy for strengthening core muscles and posture, and Back Massage for relieving muscle tension and promoting relaxation, both of which are effective in managing pregnancy back pain. | The study found significant changes in back pain scores for both gym ball and back massage interventions, with gym ball therapy being more effective. It emphasizes the importance of considering non-pharmacological treatments like gym ball exercises and back massage for pregnant women's home-based pain management. |

## DISCUSSION

The BSP has shown significant benefits for patients with chronic nonspecific LBP (cnsLBP). This was reflected in a study of 306 participants, which showed that sedentary behaviour can be reduced through this BSP program. It was also seen that increased activity involvement and lower pain intensity were in the BSP therapy group compared to the regular exercise therapy group. Of course, BSP education can significantly increase physical activity and reduce LBP<sup>12</sup>. This is supported not only by one study; various studies have also shown that education can be a tool to overcome LBP, thereby improving the quality of life of patients with LBP<sup>22</sup>. Activation of endogenous pain inhibitory mechanisms has also been shown to be a result of exercise therapy, thus supporting pain management<sup>12,23</sup>. Improved self-management of LBP can be achieved

through structured group physical activity, with a multifaceted approach that includes flexibility, aerobic fitness, core activation, and muscle strength<sup>14</sup>. Group dynamics in physical activity interventions directly promote motivation among participants and social support<sup>24,25</sup>. Combining dietary advice with self-monitoring tools, such as pedometers, supports positive health outcomes and sustained engagement to improve fitness and body composition<sup>26</sup>. Structured physical activity, when appropriately implemented, can significantly reduce pain and improve quality of life for individuals with chronic LBP<sup>26,27</sup>. Social interaction and physical activity not only improve physical health but can also enhance psychological well-being<sup>26,28</sup>. A rehabilitation program that combines pain management strategies with psychological programs in older individuals with acute vertebral compression fractures (VCF) can reduce pain intensity and increase activity in LBP sufferers<sup>29</sup>. Early

rehabilitation, including therapeutic exercise, is significant for improving physical activity and function and can reduce pain in VCF patients<sup>29,30</sup>. Broadly, combining physical rehabilitation and psychological support can reduce stress and increase physical activity<sup>29</sup>.

Regular physical activity therapy can relieve LBP in the pregnant population<sup>16</sup>. Supported by<sup>31</sup>, stating that regular exercise can significantly reduce pain intensity in pregnant women. Proper education for pregnant women by providing material related to physical activity can be a means of reducing LBP complaints. This is evidence that the integration of these interventions can be included in prenatal care<sup>32</sup>. 70% of pregnant women experience discomfort due to lower back pain during pregnancy; this has been widely documented<sup>33</sup>.

Swiss ball therapy exercises have also been shown to be effective in treating CLBP, specifically in individuals with sedentary jobs<sup>18</sup>. Spinal stabilization and motor control can also be improved with Swiss ball exercises. The unstable surface of the Swiss ball can increase muscle activation and core stability, which are essential for managing CLBP<sup>34,35</sup>. More broadly, the Swiss ball can target local muscles, thereby improving spinal stability and reducing discomfort associated with prolonged sitting<sup>36,37</sup>.

Simultaneously performing physical exercises is effective in managing LBP<sup>19</sup>. Other studies have shown that an integrated, multimodal approach can relieve back pain. Combining cognitive behavioral therapy with exercise can improve pain relief outcomes. Although not consistently increased, the majority of cases with the combined intervention consistently increased<sup>38</sup>. Although the effects of these interventions are significant, without the sustainability of the intervention program in individuals with LBP, the effects will diminish over time<sup>39</sup>. Specific muscle-strengthening exercises have a positive impact on functional improvement in people with LBP<sup>7</sup>.

One viable option for managing LBP is Transcutaneous Electrical Nerve Stimulation (TENS) Therapy<sup>15</sup>. TENS shows variable efficacy across individuals<sup>40</sup>. TENS's capacity to activate nerve fibres, which alter pain perception by processes such as endogenous opioid production and modifications in nerve conduction, lends credence to its effectiveness<sup>41</sup>. TENS is a popular choice for pain relief because of its safety, affordability, and simplicity of application<sup>42</sup>. This is consistent with research showing that TENS is a successful non-pharmacological treatment for several pain conditions, including persistent LBP<sup>40</sup>.

Exercise ball therapy is a non-pharmacological intervention that can naturally reduce back pain in pregnant women. Exercise ball therapy showed higher effectiveness in reducing pain during the third trimester of pregnancy<sup>21</sup>. This is supported by other studies that state that relaxation techniques and the role of physical activity can help manage discomfort during pregnancy<sup>43</sup>. Non-pharmacological

approaches, such as exercise, have excellent effects on pain management. The effectiveness of acupuncture therapy in reducing the intensity of back pain in pregnant women in the third trimester<sup>44</sup>.

In summary, cnsLBP management benefits from multifaceted interventions, notably the BSP, which effectively reduces sedentary behavior, increases physical activity, and lowers pain intensity compared to standard exercise therapy. Successful strategies include structured group physical activity, which fosters social support and motivation, and combined approaches integrating dietary advice and self-monitoring tools. Therapeutic exercise is vital for pain management in various populations, including pregnant women, where regular physical activity significantly alleviates LBP. Swiss ball therapy effectively targets muscle activation, enhances spinal stability, and helps manage discomfort associated with prolonged sitting. Non-pharmacological interventions, including exercise ball therapy, also demonstrate promise for pain relief.

## CONCLUSION

Exercise is an effective therapeutic strategy for managing LBP. Meanwhile, multiple therapeutic approaches have shown effectiveness to manage CLBP in various population types, including pregnant women, individuals with sedentary lifestyles, and athletes. Interventions such as structured physical activity and educational programs have been shown to significantly reduce LBP and improve quality of life. At the same time, complementary therapeutic exercises, including cognitive therapy, can enhance a holistic approach to pain management. Several non-pharmacological interventions have also emerged to manage LBP, including TENS and exercise ball therapy. Collectively, these findings provide evidence that psychological and physical factors can together constitute a comprehensive rehabilitation strategy. In the future, exploration of these pain management modalities is needed of diverse populations.

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## AUTHOR CONTRIBUTION

Jaiddin KN: Conception, Design, Analysis, Interpretation, Drafting and Revising, and Final Approval

Justine M: Interpretation of, Drafting and Revising, and Final Approval

Zahari Z: Conception, Design, Analysis, Interpretation, Final Approval

## REFERENCES

- Altug Z. Lifestyle Medicine for Chronic Lower Back Pain: An Evidence-Based Approach. *Am J Lifestyle Med.* 2021; 15(4): 425–33.
- Essman M, Lin CY. The Role of Exercise in Treating Low Back Pain. *Curr Sports Med Rep.* 2022; 21(8): 267–71.
- Anheyer D, Klose P, Koch AK, Haller H, Dobos G, Cramer H. Comparative efficacy of different exercise interventions in chronic nonspecific low back pain: protocol of a systematic review and network meta-analysis. *BMJ Open.* 2020; 10(8): 1–7.
- Hirota R, Teramoto A, Murakami T, Yoshimoto M, Iesato N, Yamashita T. Effects and limitations of home-based motor-control exercise for chronic low back pain: A single-centre prospective study. *PLoS One.* 2023; 18(4): 1–10.
- Baharuddin MY, Kudri MH, Aminudin SNA. Effect of Core Stabilization Exercise for Nonspecific Low Back Pain among Athletes. *Int J Clin Invent Med Sci.* 2021; 3(1): 18–25.
- Wahyuni W, Kurnia NE. The effectiveness of core stability exercises on pain in patients with low back pain: a meta-analysis. *Phys Ther J Indonesia.* 2023; 4(1): 85–90.
- de Jesus FLA, Fukuda TY, Souza C, Guimarães J, Aquino L, Carvalho G et al. Addition of specific hip strengthening exercises to conventional rehabilitation therapy for low back pain: a systematic review and meta-analysis. *Clin Rehabil.* 2020; 34(11): 1368–77.
- Zhu F, Zhang M, Wang D, Hong Q, Zeng C, Chen W. Yoga compared to non-exercise or physical therapy exercise on pain, disability, and quality of life for patients with chronic low back pain: A systematic review and meta-analysis of randomized controlled trials. *PLoS One.* 2020; 15(9): 1–21.
- Wahyuni W, Kurnia NE. The Effectiveness of Core Stability Exercises on Pain in Patients with Low Back Pain: A Meta-Analysis. *Phys Ther J Indonesia.* 2023; 4(1): 85–90.
- Nwodo OD, Ibikunle PO, Ogbonna NL, Ani KU, Okonkwo AC, Eze CJ et al. Review of Core Stability Exercise Versus Conventional Exercise in the Management of Chronic Low Back Pain. *Afr Health Sci.* 2022; 22(4): 148–67.
- Navas Otero A, Calvache Mateo A, Martín Núñez J, Valenza-Peña G, Hernández SH, Ortiz Rubio A et al. The Effectiveness of Combined Exercise and Self-Determination Theory Programmes on Chronic Low Back Pain: A Systematic Review and Meta-Analysis. *Healthcare.* 2024; 12(3): 382.
- Hock M, Járomi M, Prémusz V, Szekeres ZJ, Ács P, Szilágyi B et al. Disease-Specific Knowledge, Physical Activity, and Physical Functioning Examination among Patients with Chronic Nonspecific Low Back Pain. *Int J Environ Res Public Health.* 2022; 19(19): 1–9.
- Honcharov A, Ruban L, Litovchenko A, Okun D, Turchinov A. Physical therapy for old-timer athletes with chronic back pain. *Physiotherapy Quarterly.* 2020; 28(2): 20–4.
- Bloxham SR, Layden J, Jane B, Peers C, Scragg S. The longitudinal effects of a physical activity programme on the physical fitness and disability of back pain patients: Service evaluation. *J Back Musculoskelet Rehabil.* 2020; 33(1): 7–13.
- Purim-Shem-Tov Y, Daniel JP, Dyer K, Lavin M, Chien N, Shah S. Comparison of Routine Care Versus Transcutaneous Electrical Nerve Stimulation (TENS) for Treatment of Back Pain in the ED. *Arch Emerg Med Intens Care.* 2021; 4(1): 1–8.
- Maidawilis MSD, Welis W, Alimuddin A, Chaeroni A. The Effect of Endorphin Massage and Physical Activity on Reducing Back Pain Intensity of Pregnant Women. *Int J Human Movement Sports Sci.* 2022; 10(4): 633–7.
- Kataoka H, Hirase T, Goto K, Nomoto Y, Kondo Y, Nakagawa K et al. Effects of a Rehabilitation Program Combined with Pain Management That Targets Pain Perception and Activity Avoidance in Older Patients with Acute Vertebral Compression Fracture: a Randomised Controlled Trial. *Pain Res Manag.* 2023; 2023(2): 1–11.
- Kannabiran B, Sithara JA, Mugaviya N. A Comparative Study on the Effectiveness of Spine Stabilization Exercises Devoid of Swiss Ball and Dynamic Spine Stabilization Exercises with Swiss Ball in Patient with Low Back Pain (LBP). *Acta Sci Neurol.* 2022; 5(7): 30–9.
- Hamadou A, Kouassi JP, Minye EE, Mbouh S, Bidzoni P, Gbenou JD et al. Cumulative effects of Swedish massage and physical exercise on anthropometric parameters and pain intensity in women suffering from low back pain in Yaounde (Cameroon). *Int J Phys Educ Sports Health.* 2023; 10(6): 175–81.
- Cahyani IA, Winarsih S, Arfiana A. The Effect of Endorphin Massage towards Decreasing Low Back Pain in Third Trimester Pregnant Women. *Midwif Nurs Res.* 2020; 2(1): 41–5.
- Hasnia H, Dinengsih S. The Differences in Effect Between Back Massage Therapy and Gym Ball on Back Pain in Pregnant Women Third Trimester. *Jurnal Midpro.* 2024; 15(2): 289–97.
- Adenis N, Gosselin K, Stetsenko N, Thevenon A. Clarification of the "pain neuroscience education" concept in the management of patients with persistent low back pain: A scoping review. *J Back Musculoskelet Rehabil.* 2023; 36(5): 995–1010.
- Biçer B, Sişli T, Fakioglu M, Cilli K, Gökdemir CE. Nonspecific chronic low back pain: which exercise? *Ankara Üniversitesi Beden Eğitimi ve Spor Yüksekokulu Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi.* 2022; 20(3): 193–209.



24. Zimmer C, McDonough MH, Hewson J, Toohey A, Din C, Crocker PRE et al. Experiences with Social Participation in Group Physical Activity Programs for Older Adults. *J Sport Exerc Psychol.* 2021; 43 (4): 335–44.
25. Bong May Ing J, Singh DKA, Tan MP, Adam Bujang M, Tiong IK, Whitney J et al. Group-based exercise interventions for community-dwelling older people in Southeast Asia: A systematic review. *Australas J Ageing.* 2023; 42 (4): 624–37.
26. Otones P, García E, Sanz T, Pedraz A. A physical activity program versus usual care in the management of quality of life for pre-frail older adults with chronic pain: randomized controlled trial. *BMC Geriatr.* 2020; 20(1): 1–9.
27. Lai DWL, Ou X, Jin J. A Quasi-Experimental Study on the Effect of an Outdoor Physical Activity Program on the Well-Being of Older Chinese People in Hong Kong. *Int J Environ Res Public Health.* 2022; 19(15): 1–8.
28. Arkkukangas M, Strömqvist Bååthe K, Ekholm A, Tonkonogi M. Short Multicomponent Group Exercise Intervention Promotes Long-Term Physical Activity Habits among Community-Dwelling Older Adults during COVID-19 Restrictions: A Cohort Study. *Int J Environ Res Public Health.* 2022; 19(22): 1–10.
29. Ikeda T, Suzuki T, Takagi M, Murakami M. Effect of Early Rehabilitation Treatment on Activities of Daily Living in Patients Receiving Conservative Treatment for Vertebral Compression Fracture. *Prog Rehabil Med.* 2021; 6(12): 1–15.
30. Scaturro D, Tomasello S, Mauro GL. Back pain, postural balance and quality of life in vertebral fragility fractures: a prospective cohort study. *Int J Bone Fragility.* 2023; 3(3): 83–8.
31. Tombers N, Grob M, Ollenburg K, Appicelli M, Cabelka CA. Effects of Exercise on Lumbopelvic Pain During Pregnancy: A Systematic Review and Meta-analysis. *J Womens Health Phys Therap.* 2023; 47(1): 36–45.
32. Astuti Y, Nurmaguphita D, Wijayanti E, Apriliani N. Self-Empowerment of Pregnant Women to Maintain Wellness During Pregnancy. *Proceed Int Conf Community Service.* 2023; 1(1): 294–8.
33. Salari N, Mohammadi A, Hemmati M, Hasheminezhad R, Kani S, Shohaimi S et al. The global prevalence of low back pain in pregnancy: a comprehensive systematic review and meta-analysis. *BMC Pregnancy Childbirth.* 2023; 23(1): 1–13.
34. Lim CG. Comparison of the effects of joint mobilization, gym ball exercises, and breathing exercises on breathing pattern disorders and joint position sense in persons with chronic low back pain. *Phys Ther Rehabil Sci.* 2020; 9(1): 25–35.
35. Marani IN, Subarkah A, Octrialin V. The Effectiveness of Core Stability Exercises on Increasing Core Muscle Strength for Junior Swimming Athletes. *Int J Human Mov Sports Sci.* 2020; 8(6A): 22–8.
36. Miri H, Safari A, Dostdar Rozbahani A, Habibi M. The Effect of a Course of Swiss Ball Training and Ear Acupuncture on Pain and Endurance of Trunk Muscles in People with Low Back Pain. *J Arch Military Med.* 2022; 10(4): 1–7.
37. Lee SM, Lim HS, Byun HJ, Kim MJ. Changes of abdominal muscle activity according to trunk stabilization exercises using a Swiss ball. *Phys Ther Rehabil Sci.* 2020; 9(1): 18–24.
38. Hong SJ, Park J, Park S, Eze B, Dorsey SG, Starkweather A et al. Software-based interventions for low back pain management: A systematic review and meta-analysis. *J Nurs Scholarship.* 2024; 56(2): 206–26.
39. Puschmann AK, Lin CI, Wippert PM. Sustainability of a Motor Control Exercise Intervention: Analysis of Long-Term Effects in a Low Back Pain Study. *Front Sports Act Living.* 2021; 3(7): 1–8.
40. Wulansari D, Marzuqi I, Nur Arniati L, Surya Saputra B. Effect of transcutaneous electrical nerve stimulation (TENS) on the patients with chronic low back pain: systematic review. *J Adv Res Med Health Sci.* 2024; 10(3): 41–8.
41. Elshinnawy AM, Eraky ZS, Abdelaziz SS, Abd Elrahman NAF. Effect of cold application versus transcutaneous nerve stimulation on chemotherapy induced diabetic peripheral neuropathy post mastectomy. *Physiother Res Int.* 2024; 29(1): 1–11.
42. Muhammet Tugay, Ayhan Kul. Efficacy of Interferential Current Therapy in Patients Diagnosed with Subacromial Impingement Syndrome. *Eurasian J Med.* 2023; 55(3): 192–8.
43. Jannah M, Rahmawati A. The Effect of Breathing Relaxation Techniques and Body Exercises on The Decrease of Pregnant Women's Discomforts in The Third Trimester. *J Issues Midwif.* 2023; 7 (1): 31–9.
44. Pawestri P, Yunitasari E, Khayati N, Pranata S. Effectiveness of progressive muscle relaxation compared to BL 23 and GV 3 point acupressure therapy in reducing back pain intensity in third-trimester pregnant women. *Scr Med (Brno).* 2024; 55(2): 173–9.

